KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SBC 201 (N) : ADVANCED PROTEINS AND ENZYMOLOGY

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DATE: TUESDAY 27TH MARCH 2012 **TIME: 2.00 P.M. - 4.00 P.M.**

INSTRUCTIONS

***Section A**: Answer **ALL** the Questions (1 mark each)*

1. The role of an enzyme in an enzyme catalyzed reaction is to:

   A) ensure that the product is more stable than the substrate.

   B) make the free energy change for the reaction more favourable.

   C) increase the rate at which substrate is converted to product.

   D) ensure that all the substrate is converted to product.

   E) do none of the above.

2. The benefit of measuring the initial rate of a reaction, V_o is that at the beginning of a reaction:

   A) changes in [S] are negligible, so [S] can be treated as a constant.

   B) [ES] can be measured accurately.

   C) $V_o = V_{max}$.

   D) changes in KM are negligible, so K_M can be treated as a constant.

   E) varying [S] has no effect on V_o.

3. The steady state assumption, as applied to enzyme kinetics, implies:

   A) $K_M = K_S$

   B) the maximum velocity occurs when the enzyme is saturated.

   C) the ES complex is formed and broken down at equivalent rates.

   D) the K_M is equivalent to the cellular substrate concentration.

   E) the enzyme is regulated.

4. The following data were obtained in a study of an enzyme known to follow Michaelis-Menten kinetics:

V_o (μmol/min)	Substrate added (mmol/L)
217	0.80
325	2.0
433	4.0
488	6.0
647	1000

The K_M for this enzyme is approximately:

A) 1mM

B) 2mM

C) 4mM

D) 6mM

E) 1000mM

5. The double reciprocal transformation of the Michaelis-Menten equation, also called the Lineweaver-Burk plot, is given by:

$1/V_o = K_M/(V_{max}[S]) + 1/V_{max.}$

To determine the K_M from a double reciprocal plot, you would:

A) take the x-axis intercept where $V_o = V_{max}/2$.

B) take the reciprocal of the x-axis intercept.

C) multiply the reciprocal of the y-axis intercept.

D) take the reciprocal of the y-axis intercept.

E) multiply the reciprocal of the y-axis intercept by -1.

6. Enzyme X exhibits maximum activity at pH = 6.9. X shows a fairly sharp decrease in its activity when the pH goes much lower than 6.4. One likely interpretation of this pH activity is that:

A) the reaction relies on specific acid base catalysis.

B) a His residue on the enzyme is involved in the reaction.

C) a Glu residue on the enzyme is involved in the reaction.

D) the enzyme is found in gastric secretions.

E) the enzyme has a metallic cofactor.

7. The role of the metal ion Mg^{2+} in catalysis by enolase is to:

A) act as a general acid catalyst.

B) act as a general base catalyst.

C) facilitate general acid catalysis.

D) facilitate general base catalysis.

E) stabilize protein conformation.

8. Which of the following statements about allosteric control of enzymatic activity is false?

A) allosteric proteins are general composed of several subunits.

B) heterotrophic allosteric effectors compete with substrate for binding sites.

C) binding of the effector changes the conformation of the enzyme molecule.

D) an effector may either inhibit or activate an enzyme.

9. Myoglobin and the subunits of hemoglobin have:

A) very similar primary and tertiary structures.

B) very similar primary structures, but different tertiary structures.

C) very similar tertiary structures, but different primary structures.

D) very different primary and tertiary structures.

E) no obvious structural relationship.

10. Which of the following is not correct concerning 2,3-bisphosphoglycerate (BPG)?

A) it increases the affinity of hemoglobin for oxygen.

B) it binds at a distance from the heme groups of hemoglobin.

C) it is normally found associated with the hemoglobin molecules that are extracted from red blood cells.

D) it is an allosteric modulator.

E) it binds with lower affinity to fetal hemoglobin than to adult hemoglobin.

11. Lactate dehydrogenase belongs to which main class of enzymes?

A) Ligases

B) Lyases

C) Oxidoreductases

D) Isomerases

12. All the following gastrointestinal enzymes are secreted as zymogens except:

A) Ribonuclease

B) Pepsin

C) Chymotrypsin

D) Trypsin

13. A metabolic pathway proceeds according to the scheme,

$R \rightarrow S \rightarrow T \rightarrow U \rightarrow V \rightarrow W$.

A regulatory enzyme, X, catalyzes the first reaction in the pathway. Which of the following is most likely correct for this pathway?

A) the last reaction will be catalyzed by a second regulatory enzyme.

B) either metabolite U or V is likely to be a positive modulator, increasing the activity of X.

C) the first product, S, is probably the primary negative modulator of X, leading to feedback inhibition.

D) the last product, W, is likely to be a negative modulator of X, leading to feedback inhibition.

E) the last product, W, is likely to be a positive modulator, increasing the activity of X.

14. How is trypsinogen converted to trypsin?

A) Two inactive trypsinogen dimers pair to form an active trypsin tetramer.

B) An increase in Ca^{2+} concentration promotes the conversion.

C) Proteolysis of trypsinogen forms trypsin

D) Trypsinogen dimers bind an allosteric modulator, cAMP, causing dissociation into active trypsin monomers.

E) A protein kinase catalyzed phosphorylation converts trypsinogen to trypsin.

15. All the enzymes are increased in myocardial infarction except:

A) Lactate dehydrogenase

B) sGOT

C) CPK

D) Alkaline phosphatase

16. Serum amylase is highly raised in:

A) diabetes mellitus

B) liver disorders

C) acute pancreatitis

D) bone disorders

17. Number of isoenzymes of LDH in serum are:

A) 2

B) 3

C) 5

D) 6

18. An example of lyases is:

(A) Glutamine synthetase

(B) Fumarase

(C) Cholinesterase

(D) Amylase

19. A sigmoidal plot of substrate concentration ([S]) verses reaction velocity (V) may Indicate:

(A) Michaelis-Menten kinetics

(B) Co-operative binding

(C) Competitive inhibition

(D) Non-competitive inhibition

20. The enzyme which can add water to acarbon-carbon double bond or removewater to create a double bond withoutbreaking the bond is:

(A) Hydratase

(B) Hydroxylase

(C) Hydrolase

(D) Esterase

Section B: Answer ALL the Questions (5 marks each)

1. Write out the equation that describes the mechanism for enzyme action used as a model by Michaelis-Menten. List the important assumption used by Michaelis-Menten to derive a rate equation for this reaction.

2. Explain the mechanism of detoxification of NO in muscle and blood.

3. Show the steps involved in the transformation of the Michaelis-Menten equation to $V_o = (K_{CAT}/K_M)\ [E][S]$; explain the meaning of each symbol involved in this equation.

4. Explain the situations that reduce the MWC model equation to that of a rectangular hyperbola.

5. Explain why does pH affect the activity of an enzyme?

6. You are studying the enzyme alcohol dehydrogenase that catalyses this reaction:
   $NAD^+ + \text{ethanol} \rightarrow NADH + H^+ + \text{acetaldehyde}$
   You discover that mercury ion (Hg^+) at a concentration of 1 mM inhibits the enzyme by 95%. You find by appropriate kinetic experiments that the enzyme's apparent K_M for ethanol is the same in the presence and the absence of Hg^+. What does this tell you about the kind of inhibition caused by Hg^+? How can the inhibitor constant of this type of inhibition be determined?

Section C: Answer any TWO Questions (10 marks each)

1. Explain the use of the oxidase system in the assay of blood glucose.
2. Explain the use of lactase as a digestive aid.
3. Give well labeled reaction schemes for bisubstrate reactions.